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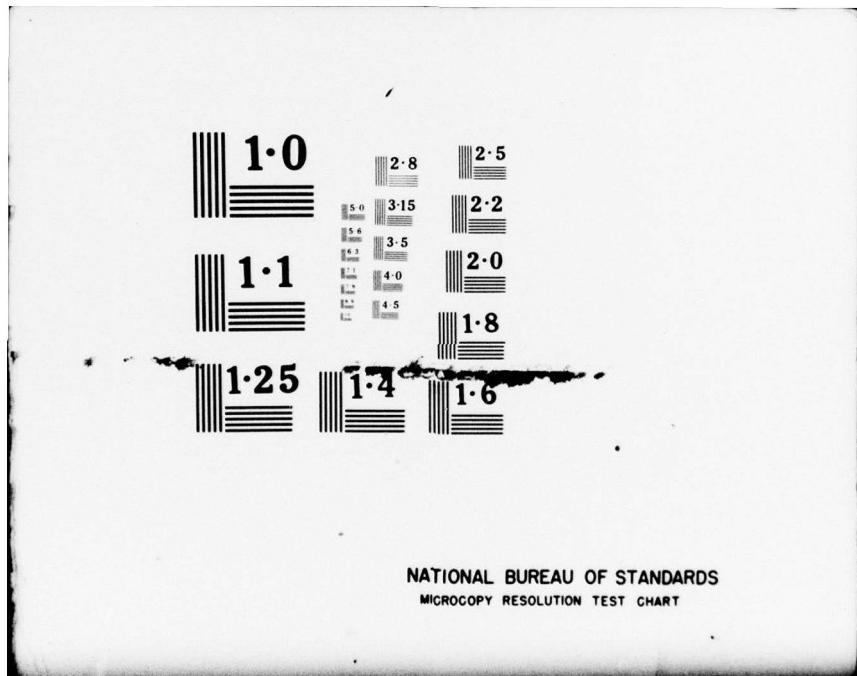
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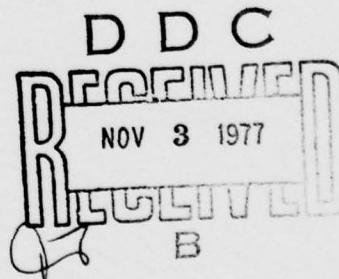
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RESEARCH IN FRANCE

ALBERT BARCILON

15 SEPTEMBER 1977



UNITED STATES OF AMERICA

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER 14 ONRL R-10-77	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) RESEARCH IN FRANCE		5. TYPE OF REPORT & PERIOD COVERED Technical rep't., 9
6. 7. AUTHOR(s) 10 Albert Barcilon	6. PERFORMING ORG. REPORT NUMBER	
7. PERFORMING ORGANIZATION NAME AND ADDRESS Office of Naval Research Branch Office London, Box 39, FPO New York 09510		8. CONTRACT OR GRANT NUMBER(s)
11. CONTROLLING OFFICE NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
		12. REPORT DATE 15 Sep 77
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		13. NUMBER OF PAGES 26 12 196
		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Research in France French research structure and administration Trends in French science		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report reviews some of the mechanisms of research support in France as well as the major organizations dealing with research. It also provides a glimpse at the mood of French scientists in the face of shrinking research budgets.		

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RESEARCH IN FRANCE

I. Introduction

This report provides an overall view on research-related matters in France. It does not boast of being an exhaustive review of this topic but rather it is a compilation of impressions gleaned from discussions with French scientists and from the intermittent reading of the French press.

The present status of research reflects the evolution of science in the last 100 years. A century ago, scientists felt that, given enough time, science could provide understanding on almost any subject. Fundamental research, which proceeded at its own pace ignoring deadlines, was fostered in small laboratories by individuals working alone on a shoestring budget or with a few students. Names like Pasteur, Curie, Rutherford, and many others provide a perfect illustration of the above concepts. Science was not costly; it was considered neither good nor bad.

Nowadays science, and especially megascience, is an effort which engulfs a substantial amount of a country's resources: government has become its main supporter, therefore the taxpayer is now more and more involved in matters pertaining to science funding. In recent years, he has become more critical of the scientific areas that are supported. The unshakeable trust in science that existed a century ago has been jolted by the point of view of both the man in the street and the scientist. According to surveys carried out in France, the layman seems to have one of two attitudes: either he thinks that science is all bad and is the root of all of society's ills and, therefore, would like scientific expenditures to be curtailed; or he thinks that science does not receive sufficient support to solve present-day problems. Fortunately for the scientific community, 71% of the group sampled are in favor of scientific support.

An increased concern for more relevant problems is responsible for a shift away from fundamental research dealing with the physics and chemistry of matter towards problems which deal with man, his well-being, and his environment. Man is therefore spending more time and effort investigating himself and his environment. He finds himself at both ends of the spectrum: he is the investigator and the investigated. This "quadratic nonlinearity" of man looking at man has modified some of the scientific trends and resulted in greater emphasis being placed on social, economic, medical, and environmental sciences. Again, a recent survey in France showed that 79% felt that increased funds ought

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to be spent to improve man's environment, and an impressive 96% wanted to see an increased support of medical research; 40% felt that military research should be decreased.

To the above somewhat general remarks one must append remarks which are more pertinent to the French scene. Before 1945 France was primarily an agricultural nation, with an elite of philosophers, writers and thinkers. After WWII it emerged as an industrial nation. Most of the partitions of the French administration and civil service, some of its inertia, and the manner in which most graduates of the top Ecoles still aspire to a high civil-service position (see ESN 30-8:360) in an administrative capacity point to fossilized traditions that predate WWII. The above is forcefully brought out by a quote by Mr. Peyrefitte, Justice Minister and author of the best seller *Le Mal Français* (The French Illness), in an interview with the *Herald Tribune*, May 1977: ". . . the French must learn to love trade, industry, techniques and, therefore, their exporters, their industrialists, and their technicians. . . ."

II. General Considerations

The reader is urged to turn to recent ONRL reports (R-10-75 and R-11-75) entitled "Centralization and Vigor—French Education and Research (Part I) and—Organization and Funding of Research in France (Part II)." Aside from providing valuable additional information, their perspective on this subject is somewhat different.

I will briefly describe some of the ways in which research is funded and carried out in France. I have attempted to go beyond the formal presentation of a static structure and have tried to understand the human element and the difficulties experienced by the French scientist. These views will be presented in paragraph VI to which the reader not interested in the French research structure and organization can turn. Again, I would reiterate that my impressions have been gleaned mainly from brief liaison visits in various laboratories, by talking with several friends and scientists, and by intermittently reading the French press on this subject.

Research is carried out in both the public and private sector. The public sector encompasses (i) teaching establishments and (ii) public organizations that deal with a specialized field. In (i) we find the Universities, the "Ecole Nationales Supérieures d'Ingénieurs," the "Grandes Ecoles," (see ONRL R-11-76 and ESN 30-8:360), the Centers supported by the "Sécrétariat d'Etat aux Universités" (SEU),¹ the "Grands Etablissements," and the "Centre National de la Recherche

¹For a list of acronyms see Figure 1 at the end of this report.

"Scientifique" (CNRS). Most of these will be discussed in greater detail below. In (ii) we find the "Centre d'Energie Atomique" (CEA) with a budget of 2×10^6 FF, the "Institut National de la Santé et de la Recherche Médicale" (INSERM) (34×10^6 FF), the "Institut National de la Recherche Agronomique" (INRA) (514×10^6 FF), "Centre National d'Etudes Spatiales," (CNES) (907×10^6 FF), the "Centre National pour l'Exploitation des Océans" (CNEXO) (170×10^6 FF), and the "Office de la Recherche Scientifique et Technique Outre-Mer (ORSTOM) (179×10^6 FF).

Table I summarizes the research expenditures for 1975 both in the public and in the private sector.

Table I: Research and Development expenditure - 1975

PUBLIC SECTOR

"Enveloppe recherche".....	8,213 MF	50.6 %
Defence.....	5,000 MF	30.8 %
Funding of universities (1).....	1,440 MF	8.8 %
Aeronautics (civil).....	783 MF	4.8 %
(of which Concorde: 377 MF)		
Others (2).....	801 MF	5.0 %
 <u>PRIVATE SECTOR</u>	approximately	9,800 MF
 TOTAL approximately	26,000 MF	

- (1) This is only a part of the money devoted to research by universities. It is not a part of the "enveloppe recherche" (defined below) and consists mainly of salaries and maintenance.
- (2) Including funds for the "Centre National d'Etudes des Télécommunications" (CNET), which are not included in the "enveloppe recherche."

Research in France can also be divided into that falling within the so-called "enveloppe recherche" (research envelope) and that which falls outside. The investments included in the enveloppe recherche can be broken down into four main categories which are listed in Table II.

To complicate matters somewhat, the research funds are channelled through various ministries; there are about 42 ministries and "Sécrétariats d'Etat," of which about 15 exert a profound influence on research activity (See Fig. 1). For example, the Ministry of Defense supports the "Ecole

TABLE II: Distribution of investments by types of research (1975)

Fundamental research.....	1,521.7 MF
Research with social economic objectives..... (health, agriculture)	418.6 MF
Research with industrial objectives.....	751.9 MF
Large scale programmes.....	1,779.9 MF
Others.....	79.4 MF
TOTAL.....	4,551.5 MF

"Polytechnique" as one of its schools as well as most of the research at the "Office National d'Etudes et de Recherches Aerospatiales" (ONERA) (See ESN 30-7:297), the Ministry of Agriculture supports the Institut National de la Recherche Agronomique (INRA), etc. Thus, the role of the ministries is to orchestrate research in a given sector on a national scale.

Table III lists the 1975-1976 levels of funding of various ministries and their institutes. Finally, the enveloppe recherche is itself sliced into disciplines or sectors, and Table IV illustrates the supports and trends in these areas.

The four main thrusts of the enveloppe recherche are:

A. Basic research

Funding in this area is to increase by some 3.7% per year. The policy has been to renew heavy equipment used in nuclear studies, to build laboratories, and to construct devices capable of probing atmospheric layers. Biology has also received larger capital outlay.

B. Socio-economic research

Socio-economic research strives to improve the quality of life. In the last few years, its average yearly increase of some 16% has been enormous. It deals with

TABLE III: The "enveloppe recherche" by ministries and research establishments*
(MF) (1975)

	Capital expenditure		Current expenditure		Total	
	1975	1976	1975	1976	1975	1976
Industry and research.....	3891	4317	391	435	4282	4752
CEA	2250	2461	—	—	2250	2461
CNES	639	711	184	199	822	910
CNEXO	88	94	68	76	156	171
Plan calcul	300	300			300	300
IRIA	27	29	37	44	64	73
{ "fonds de la recherche	246	344				
DGRST			12	16	525	655
"aide au développement"	266	295				
Direction des Mines	75	83	90	100	165	182
Foreign affairs.....	—	—	279	302	279	302
Cooperation.....	24	32	240	275	264	307
ORSTOM	12	14	142	166	154	180
GERDAT	12	18	98	109	110	127
Agriculture.....	82	94	369	446	451	540
INRA	76	87	353	428	429	515
Environment, building.....	73	79	65	72	138	151
Transports.....	120	130	50	58	170	188
Universities.....	454	475	1472	2026	2196	2501
CNRS	350	375	1499	1766	1849	2141
DESUR	104	100	243	260	347	360
Quality of life.....	24	27	3	4	27	30
Health.....	50	76	270	317	320	393
INSERM	48	53	248	292	296	346
Other ministries.....	30	41	55	63	86	105
Culture	7	13	15	18	23	31
Overseas territories	15	16	12	13	26	29
Finance	—	—	—	—	—	—
Home	4	5	1	1	5	6
Justice	2	2	4	5	7	8
"Commissariat Général au Plan"	—	2	10	11	10	12
Employment	2	3	12	14	14	18
Trade	—	—	1	1	1	1
TOTAL	4748	5271	3464	3998	8213	9269

*For list of acronyms see Fig. 1

Table IV The "enveloppe recherche" by sectors (MF)

	Capital expenditure		Current expenditure		Total	
	1975	1976	1975	1976	1975	1976
Nuclear physics.....	316.64	333.53	457.48	505.11	774.12	838.64
Physics, chemistry, materials	442.16	441.97	325.99	368.97	768.15	810.94
Space.....	218.47	209.18	174.21	166.99	392.68	376.17
Ocean, atmosphere.....	207.22	233.49	184.65	200.72	391.87	434.21
Earth.....	91.54	98.70	197.01	215.79	288.55	314.49
Mathematics.....	3.57	8.07	31.39	36.03	34.96	44.10
Data processing, telecommunications.....	345.84	355.05	129.76	138.44	475.60	493.49
Biology.....	106.36	125.64	242.65	275.80	349.01	401.44
Health.....	140.56	159.24	72.16	560.44	612.44	719.68
Agriculture.....	104.03	130.83	421.92	510.20	525.95	641.03
Human sciences.....	31.98	24.62	143.03	161.92	175.01	186.54
Quality of life.....	226.89	240.21	103.15	117.79	330.04	358.00
Physical environment.....	148.56	163.57	114.44	129.59	263.00	293.16
Economic and social structures.....	18.15	38.53	92.29	108.71	110.44	147.24
Energy.....	1333.19	1453.04	87.80	109.29	1420.99	1562.33
(electronuclear programme.. other research)	1173.30	1235.00	—	—	1173.30	1235.00
	159.89	218.04	87.80	109.29	247.69	327.33
Mechanical engineering and other industries.....	282.91	334.22	155.48	181.07	438.39	515.29
Other general research.....	234.71	209.42	130.86	211.00	365.57	420.42
R & D "stricto sensu"....	4252.78	4559.31	3464.27	3997.86	7717.05	8557.17
Other activities of CEA, CNES and "Plan Calcul".....	495.70	711.50	—	—	495.70	711.50
TOTAL.....	4748.48	5270.81	3464.27	2997.96	8212.75	9268.67

public and mass transportation systems, road safety, environment, water quality, air pollution, public health, agronomical, and agricultural research to improve yield, etc.

C. Industrial research

Industrial research attempts to improve production and render French industry competitive in the world markets. Exploitation and mining of seabeds seem to be items of priority for the VIIth Plan (see Section IV). France is making a huge effort to become independent in the fields of energy and raw materials. (See ESN 31-6:235)

D. Concerted efforts

Finally, Concerted Efforts ("Grands Programmes") are conceived for political and/or strategic reasons.

The priorities for the next five years seem to concentrate on items B and C above.

The government is also striving to create new jobs for scientists. In 1976 about 437 such positions were created as compared with 189 in 1975 and 156 in 1974; this represents some 3% increase in the number of scientists. This will do much to alleviate a problem found in most French labs: the heavy equipment is there, but there are too few scientists to man it and interpret the data.

Finally, the government is pursuing its decentralization of industry and research by using limited growth, funding, and promotional schemes to encourage research to move away from Paris. I will expand on some of these points in the body of this report.

III. Mechanisms of Research Support

This section sketches the mechanisms of funding research in France and discusses the organizations involved. The reader is referred to Fig. 1 which provides an illustration of the various ramifications of the research support in France.

A. The Ministry of Industry and Research

Until very recently, to ensure a unified policy on a national scale, the Minister for Industry and Research was given the task to implement and assign the nation's research and development policy; in this task he acted as an interministerial coordinator between the various ministries. In addition, under his authority are those organizations that have received preferential treatment because of the area of research to be developed, e.g., Atomic Energy Commission (CEA);

"Centre National d'Etudes Spatiales" (CNES), The French NASA; "Plan Calcul;" and the "Centre National pour l'Exploration des Oceans" (CNEXO). This conflict of interest will no longer arise for a new Sécrétariat d'Etat à la Recherche has recently been created and will take over the coordinating activity. (See C below)

B. The "Délégation Générale à la Recherche Scientifique et Technique" (DGRST)

The DGRST, until very recently was under the Minister of Industry and Research, is now directly tied to the Prime Minister. It is supposed to aid in the elaboration, coordination and supervision of research funding. It works in conjunction with the "Commissariat Général du Plan," a group in charge of drawing up France's "Plan" (see below). It is this organization which collects all information necessary for defining a research policy and prepares the medium-term layout for research and development. In this task the DGRST interacts with the "Comité Consultatif de la Recherche" (CCRST), an advisory group, and the "Comité Interministeriel de la Recherche Scientifique et Technique" which approves or rejects some of the decisions. Also, the DGRST by means of its "Actions Concertées" (Concerted Actions) can spur research in specific areas; about 10% of its budget is devoted for this purpose. The DGRST awards contracts to public and private laboratories. In 1975 the financial effort in this area amounted to some 246MF. This steering procedure is not as flexible as it may appear at first sight, for once a new project is started, it is kept going by the DGRST until another organization can take it over. Nevertheless, this capability is used to encourage new research area and to start cooperative programs between universities and industry. Table V summarizes some of the concerted actions

C. Secrétariat d'Etat à la Recherche

At the end of March 1977 a new Secrétariat was created. Mr. Jacques Sourdille, who became the first Secrétaire d'Etat à la Recherche, is directly responsible to Prime Minister R. Barre. He is now in charge of the enveloppe recherche and will take over from the Minister of Industry the coordination of research and the establishment of research priorities.

D. The Secrétariat d'Etat Aux Universités (SEU)

This is the ministry that deals with matters pertaining to universities and some of the Grandes Ecoles and to which the CNRS is attached. Therefore, it is a rather large entity as far as research and teaching is concerned. About 30,000 faculty members of some 60 universities spend about 30-50% of their time on research; 40% of the SEU's budget goes to research support via its CNRS connection and it employs over 100,000 persons. The Minister in charge is Mme Alice Saumier-Séité, who has often been in the news headlines because

TABLE V: Typical Concerted Actions of the DGRST

Automation
Microminiaturized components and circuits
Electronic physics
Innovative electronics
General electrotechnics
Cryoelectricity
Measuring instruments
Electronics
Mechanical engineering
Metallurgy
Separation techniques using macromolecular materials
New and improved polymers
Macromolecular materials
Selective activation in organic chemistry
Analytical and applied chemistry
Assisted recovery of oil
Molecular chemistry of fluorine
Atmospheric research
Winning of subsoil resources
Geological research involving civil engineering, town planning
and land development problems
Food and agricultural technology
Biological balances and control
Proteins of unicellular organisms
Biological and medical engineering
Biological membranes: structure and functions
Biology of reproduction and growth
Immunology of organ transplants
Biology and pathology of the arterail and arterail
Biology and pathology of the arterial and arterio-capillary walls
Molecular interactions in biology
Biology and functions of the myocardium
Biology of exocrine digestive secretions
Urbanisation
Materials
Information sciences and human sciences
Economics and culture

of her attempts to reform the university and the pre-university education system (See *ESN* 30-5:211).

E. The Centre National de la Recherche Scientifique (CNRS)

The CNRS, as we have seen, is under the SEU and has a dual character: as well as carrying out research in its own laboratories, it provides financial support to universities and other research laboratories. Thus it permeates all the research sectors in France; its "laboratoires propres" (own labs) and "laboratoires associés" (joint laboratories) are located in most of the universities. Seventy percent of the entire CNRS scientific staff work in universities, but only 50% are faculty members. In 1976, the CNRS budget was 1.8 Billion FF. Around its main organization gravitate a number of institutions such as the "Institut National d'Astrophysique et de Geophysique" (INAG), "Agence National de Valorisation de la Recherche" (ANVAR) (See *ESN* 31-1:31), and the "Institut National de Physique Nucléaire et de Physique de Particles," cryptically known in France by an acronym that resembles a chemical formula: IN2P3! The CNRS employs some 19,000 persons of whom about 7,000 are researchers, and it has 131 laboratories and 207 joint labs. Similar to the DGRST, the CNRS can also spur research in a particular sector via its "Actions Thématisques Programmées" (programmed actions). This program can cross disciplinary boundaries and promote research in new fields.

Scientists are involved in the decisions regarding the support of given scientific areas, i.e., in the choice of these areas and in the selection of scientists who will do the work, by means of a "Comité National de la Recherche Scientifique" (National Committee of Scientific Research). This Committee is composed of 36 sections covering most of the scientific disciplines. The more than 1,000 participants on the Committee gather twice a year to decide on research support and to deal with recruitment and promotion of scientific staff. They prepare the "Rapport de Conjoncture" that describes the state of research and lists priorities. This report is extensively used by the DGRST in preparing the Plan or more precisely, the component of the Plan that deals with research.

IV. The VIIth Plan

The Plan is a device by which the French government organizes its resources and sets priorities and goals (See *ESN* 31-6:235); it spans a period of five years, and the VIIth Plan is to cover the time period 1976-1980. Its preparation provides an opportunity for the government, industrialists, unions, etc., to come together and discuss their aspirations. The VIIth Plan was born at a particularly difficult time as the energy and monetary crises were, and

still are, widespread international ills that are affecting all industrialized nations. The main goals of the VIIth Plan are to achieve full employment in order to reduce inequalities among Frenchmen and to improve the quality of life. Research and its support in preferential areas are being used to develop education, health, environment, and social sciences; as such research support is used as a political tool.

V. Where Research Is Carried Out

A. The Universities, the Grands Etablissements. These institutions are under the administrative control of the "Direction des Enseignements Supérieurs et de la Recherche" (DESUR) and of the SEU. They provide important support to scientific research both in staff and equipment. In 1975, DESUR spent 346 MF (104 MF in equipment, 242 MF on staff and administration) on research, the major contribution being in salaries. Faculty members generally spend about 30-50% of their time doing research and they are paid on a full-time basis. As previously mentioned, part of the CNRS budget is spent in Universities on research projects and also for support of doctoral students.

The Grands Etablissements are mainly concerned with research, although some are also involved in higher education (Collège de France, Ecole Normale Supérieure). Others tend to specialize in a specific scientific area (Observatories, Muséum d'Histoire Naturelle, etc.).

B. The Grandes Ecoles

These are primarily engineering schools that provide specialized and/or broad training in engineering. Some are independent of the university system, but all, as a rule, have a very selective entrance examination. The interested reader is referred to ONRL-R-11-76 for a more detailed discussion of these institutions. Nowadays some of the Ecoles have their own laboratories where research is being carried out in campus-like surroundings. Many are being created outside of Paris; this move is being resisted by both faculty and students who are reluctant to leave the capital.

VI. Trends

This section is devoted to some of the impressions I gleaned in my various visits to French laboratories.

A. Pure vs Applied Research

There seems to be a renewed interest in the applications of science, even though such interest probably does not always appeal to those minds only satisfied with very abstract concepts. Many

students in mathematics and physics are turning to such fields as oceanography, meteorology, etc. Also there is an increasing number of research contracts between engineering schools and industry in general. Despite efforts to eliminate it, a distinction between the universities and the engineering schools still appears to exist. As the university is considered more of a hotbed of unrest, industrialists tend to shy away from placing contracts there or hiring its graduates and turn instead to graduates of the Ecoles. This picture is slowly changing because a number of universities are beginning to grant engineering degrees (*ESN* 30-12:540). Progress is still slow, however, for they must move against tradition, and the going can be difficult.

B. The Independence of Universities; Decentralization

The Universities have become autonomous since the 1968 unrests. As such they are free to decide on what they teach and whom they appoint. Yet, once appointed the faculty member is directly under the Sécrétariat d'Etat aux Universités, i.e., Paris controls the promotion of the faculty. This situation can sometimes lead to a strange scenario in which a faculty member refuses to go along with his department's or university's decision; in parallel fashion, because of its autonomy, a university department can escape the centralized control found in Paris. This situation is probably responsible for the partial failure of decentralization. I have met faculty members of the University of Dijon who teach at Dijon (200 miles southeast of Paris) but live and work in Paris; thus Paris remains a center of attraction even for faculty that are presumed to be devoting their efforts to upgrading a provincial university. The Rhone-Alps region with Grenoble and the Marseilles region are probably the geographical areas that have acquired the most momentum as far as quality of research and teaching are concerned and are becoming small centralized areas away from Paris.

The CNRS has established several local offices in an attempt to decentralize away from Paris. Unfortunately, these offices do not have full power to make decisions, and all have to turn to Paris for the final word. I would say that research in France is still quite centralized.

C. Mobility

Research in France suffers from a lack of mobility. Exchanges between industries, universities and government laboratories are greatly encouraged, but still there are not enough actually taking place. I was told that at the CNRS new positions carrying a time limit of a maximum of three years are envisaged to help stir the system. The rigidity of the system can be illustrated by the following. The CNRS possesses several laboratories on university

campuses. These laboratories are populated by faculty members who teach and do research and by CNRS scientists who do only research. If a CNRS scientist wants to teach, he must "trade place" with a faculty member. This implies that he must find someone in exactly his own financial bracket; this must be done and approved through Paris rather than at the local university level. The problems involved are such that such a trade-off is rarely achieved.

An effort is also being made to encourage people to move from one field to another. There has been discussion of shortening the "thèse de doctorat d'Etat," which is beyond the "thèse du 3ème cycle" so as to prevent young scientists from "digging their heels in" too deeply in one subject and thus finding it difficult to move to another. Also, the age pyramid at the CNRS caused by a large intake of scientists in the 1960s results in very few positions being made available by attrition. This factor also contributes in making the system less mobile.

D. Security vs Insecurity

Most scientists in France are protected by conservative unions. They have a leveling effect as the criteria for promotion are based more on seniority, etc., rather than on outstanding achievements. Job stability in research in France is rather different from what one encounters in the US. In France a CNRS employee is a civil servant, and he does not seek research contracts. A faculty member is also paid on a full-time basis.

When I asked a faculty member of the University of Dijon who had been to the States several times which he preferred, security or insecurity, his answer was in favor of the American system.

Proposals for research projects are evaluated at the CNRS. The trend has been to submit fat documents that are hard to read and assimilate. In some sections, a given proposal will be orally debated with one team defending it and another attacking it, while the nondebators make up their own minds. Now, in some sectors of the CNRS, proposals are to be submitted in a three-page format, very much like at ONR!

Drastic accelerations and decelerations in research funding (which one witnesses in the US) are unheard of in France and probably in Europe as a whole. Funding will always go on even if the work is no longer "fashionable"—the amount of support will be decreased, however, so that there is a slow starvation of the group performing that research. Traditions often come into the picture and prevent, say in an old university, the elimination of some research specialty in favor of another.

E. Politics and Science

In March 1978 Frenchmen will vote in decisive elections, and the Left seems to stand a good chance of coming into power. What is the position of the Left as far as research is concerned? According to a recent newspaper article, they advocate creation of groups to solve specific problems and the dissolution of such groups once the problems are solved. This solution appears impractical and probably will be strongly resisted by the unions that are for the status quo.

Since the universities have always been the cradle of Left-wing ideas, should a Communist government come into power, universities might stand to benefit at the expense of other government laboratories as far as research subsidies are concerned. This is only conjecture on my part.

F. Science vs Megascience

France is striving to occupy a leading position in research by undertaking several crash programs (some multinational) in space, electronics, computers, etc. Such programs are characterized by large expensive hardware, and several research groups that I visited are in need of scientific personnel to operate this hardware. However, the problem resides in the creation of positions; once a position is created it cannot be abolished, for one is rarely fired in France. Some feel that this sustained effort to play superpower might divert France's human scientific resources at the expense of the acquisition of hardware and that young scientists might be turning to other professions for a living, for owing to the lack of scientific positions, many university graduates find it sometimes difficult to work in areas for which they have been trained.

VII. Conclusion

In conclusion, France is undergoing somewhat difficult times because of its economic problems engendered by the shortage of crude oil and raw materials; hence, the funding and growth of research have been affected. Her research potential is enormous but is somewhat hampered by the rigidity of the research system. This rigidity is caused by the still high level of centralization, the large number of government laboratories involved in research, and the lack of mobility between these laboratories and the universities. This system also has a much greater inertia than the US system as we know it because of the emphasis placed on job security.

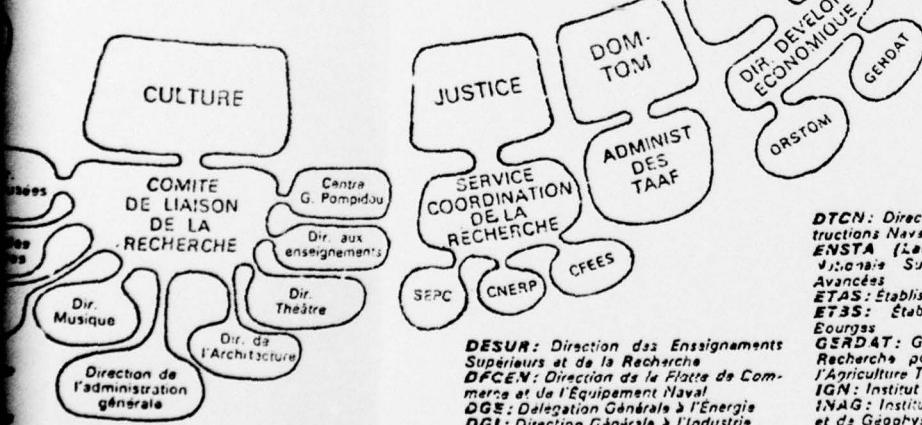
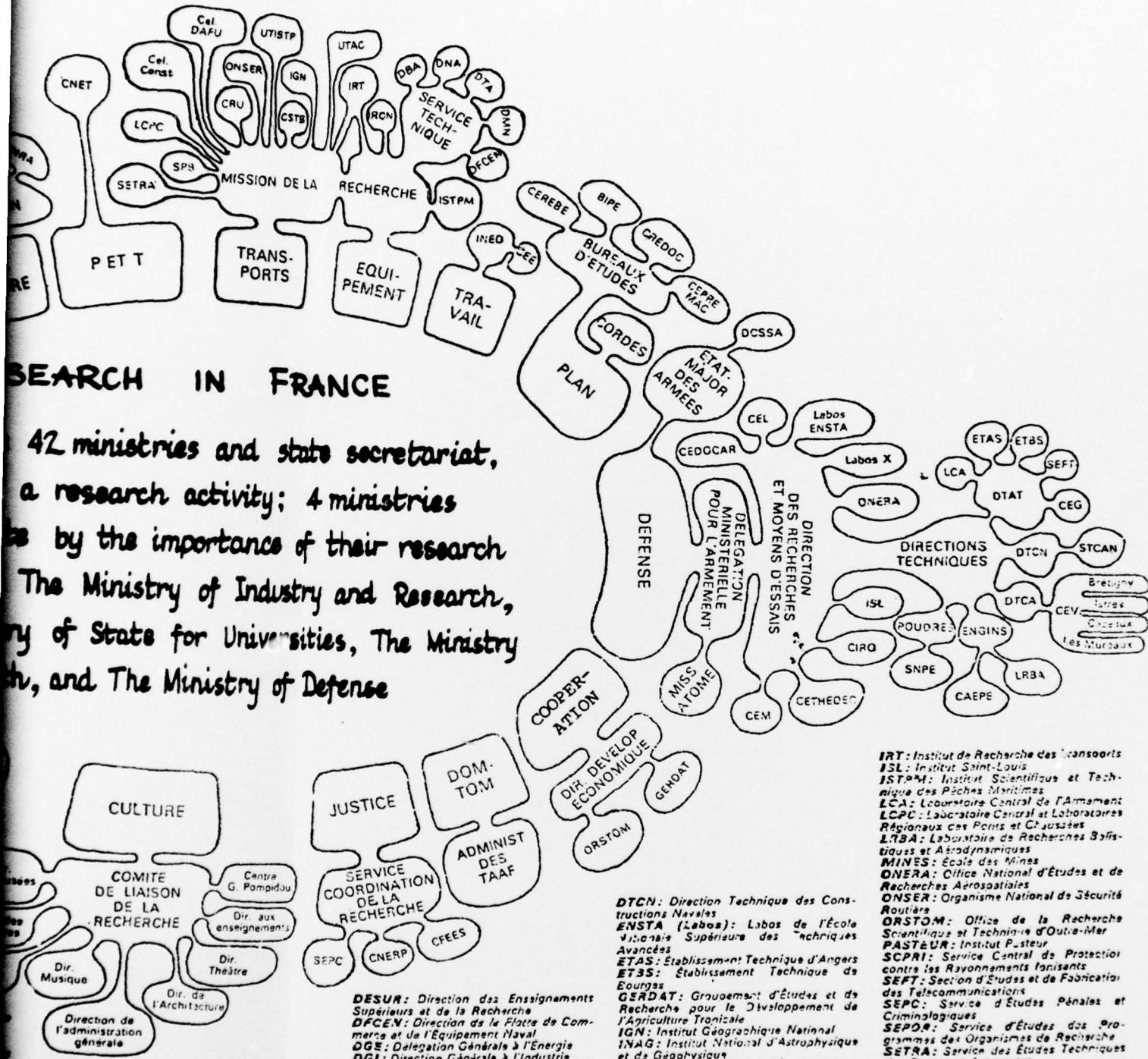
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USEFUL REFERENCES

Fig. 1 is from the periodical *Science et Vie* March 1976,
pp. 54-62.

Many of the tables are from "Research and Development in France," September 1976, published by the Scientific Service of the French Embassy in London.

The International Herald Tribune published in May 1977 a special issue entitled: "An Economic Report: The Outlook for France." It has provided a useful prospect on that country.



COREDES: Comité d'Organisation des Recherches Appliquées sur le Développement Économique et Social
CREDOC: Centre de Recherche et de Documentation sur la Consommation
CRU: Centre de Recherche de l'Urbanisme
CSTB: Centre Scientifique et Technique du Bâtiment
CTB: Centre Technique Professionnel
DRA: Direction des Bases Aériennes
DCSSA: Direction Centrale des Services de Santé

DESUR: Direction des Enseignements Supérieurs et de la Recherche
DFCEN: Direction de la Flotte de Commerce et de l'Équipement Naval
DGE: Délégation Générale à l'Energie
DGI: Direction Générale à l'Industrie
DMA: Délégation Ministérielle pour l'Aménagement
DMN: Direction de la Météorologie Nationale
DNA: Direction de la Navigation Aérienne
DOM-TOM: Départements et Territoires d'Outre-Mer
DRME: Direction des Recherches et Moyens d'Essais
DTA: Direction des Transports Aériens
DTAT: Direction Technique de l'Armée de l'Air
DTCA: Direction Technique des Constructions Aéronautiques

DTCN: Direction Technique des Constructions Navales
ENSTA (Labos): Labos de l'École Nationale Supérieure des Techniques Avancées
ETAS: Établissement Technique d'Angers
ET3S: Établissement Technique de Bours
GERDAT: Groupe d'Etudes et de Recherche pour le Développement de l'Agriculture Tropicale
IGN: Institut Géographique National
INAG: Institut National d'Astrophysique et de Géophysique
INEO: Institut National d'Etudes Demographiques
INRA: Institut National de la Recherche Agronomique
INSERM: Institut National de la Santé et de la Recherche Médicale
INPI: Institut National de Physique Nucléaire et de Physique des Particules
IRCM: Institut National de Recherches Chimiques Appliquées
IRCM: Institut de Recherche de Construction Ouvrière
IRIA: Institut de Recherche d'Informatique et d'Automatique
X (Labos): Labos de Polytechnique